Topology of feather melanocyte progenitor niche allows complex pigment patterns to emerge.

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Authors: S J Lin, J Foley, T X Jiang, C Y Yeh, P Wu, A Foley, C M Yen, Y C Huang, H C Cheng, C F Chen, B Reeder, S H Jee, R B Widelitz, C M Chuong

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Public Summary:
Color patterns of bird plumage affect animal behavior and speciation. Diverse patterns are present in different species and within the individual. Here, we study the cellular and molecular basis of feather pigment pattern formation. Melanocyte progenitors, distributed as a horizontal ring in the proximal follicle, mature to melanocytes which are transferred to the epithelium as feathers grow. Different pigment patterns form by modulating the presence, arrangement, or differentiation of melanocytes. Agouti, present in the outer dermis layer, blocks melanocyte differentiation producing unpigmented feather regions. Thus the outer dermis plays an important role in pigment patterning. Since feathers are replaced by cycling, the pigmentation patterns can be replaced at each feather generation to suit physiological needs. Thus, the evolution of stem cell niche arrangement allows complex pigment patterns to form by combining simple regulatory mechanisms.

Scientific Abstract:
Color patterns of bird plumage affect animal behavior and speciation. Diverse patterns are present in different species and within the individual. Here, we study the cellular and molecular basis of feather pigment pattern formation. Melanocyte progenitors are distributed as a horizontal ring in the proximal follicle, sending melanocytes vertically up into the epithelial cylinder, which gradually emerges as feathers grow. Different pigment patterns form by modulating the presence, arrangement, or differentiation of melanocytes. A layer of peripheral pulp further regulates pigmentation via patterned agouti expression. Lifetime feather cyclic regeneration resets pigment patterns for physiological needs. Thus, the evolution of stem cell niche topology allows complex pigment patterning through combinatorial co-option of simple regulatory mechanisms.